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REISSUE PATENT APPLICATION TRANSMITTAL

Address to:
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Attorney Docket No.	835-007.3
First Named Inventor	Bengt A. Carlson
Original Patent Number	6,039,304
Original Patent Issue Date (Month/Day/Year)	March 21, 2000
Express Mail Label No.	EL628637893US

APPLICATION FOR REISSUE OF: (check applicable box) [x] Utility Patent [ ] Design Patent [ ] Plant Patent

APPLICATION ELEMENTS

1. [x] * Fee Transmittal Form *(PTO/SB/56)* *(Submit an original, and a duplicate for fee processing)*
2. [x] Specification and Claims (*amended, if appropriate*)
3. [3] Drawing(s) *(proposed amendments, if appropriate)*
4. [x] Reissue Oath / Declaration (original or copy) *(37 C.F.R. § 1.175)(PTO/SB/51 or 52)*
5. Original U.S. Patent
   [x] Offer to Surrender Original Patent *(37 C.F.R. § 1.178)* *(PTO/SB/53 or PTO/SB/54)*
   or
   [ ] Ribboned Original Patent Grant
   [ ] Affidavit / Declaration of Loss *(PTO/SB/55)*
6. Original U.S. Patent currently assigned?
   [x] Yes [ ] No
   (If Yes, check applicable box(es))
   [x] Written Consent of all Assignees *(PTO/SB/53 or 54)*
   [x] 37 C.F.R. § 3.73(b) Statement [x] Power of Attorney

ACCOMPANYING APPLICATION PARTS

7. [ ] Foreign Priority Claim *(35 U.S.C. 119)* *(if applicable)*
8. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
9. [ ] English Translation of Reissue Oath/Declaration *(if applicable)*
10. [ ] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired
11. [ ] Preliminary Amendment
12. [ ] Return Receipt Postcard *(MPEP 503)* *(Should be specifically itemized)*
13. [ ] Other: .....

***NOTE FOR ITEMS 1 & 10:** IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).*

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REISSUE APPLICATION FEE TRANSMITTAL FORM

Docket Number (Optional): 835-007.3

Claims as Filed - Part 1

Claims in Patent	For	Number Filed in Reissue Application	(3) Number Extra	Small Entity Rate	Small Entity Fee		Other than a Small Entity Rate	Other than a Small Entity Fee
(A)	Total Claims (37 CFR 1.16(j))	(B) 42	**** 22 =	x $___ =		or	x $ 18 =	396.00
(C)	Independent Claims (37 CFR 1.16(i))	(D) 9	* 6 =	x $___ =			x $ 78 =	468.00
			Basic Fee (37 CFR 1.16(h))	$___				$ 690.00
			Total Filing Fee	$			OR	$ 1554.00

Claims as Amended - Part 2

	(1) Claims Remaining After Amendment		(2) Highest Number Previously Paid For	(3) Extra Claims Present	Small Entity Rate	Small Entity Fee		Other than a Small Entity Rate	Other than a Small Entity Fee
Total Claims (37 CFR 1.16(j))	***	MINUS	**	* =	x $___ =		or	x $___ =	
Independent Claims (37 CFR 1.16(i))	***	MINUS	*****	=	x $___ =			x $___ =	
				Total Additional Fee	$			OR	$

* If the entry in (D) is less than the entry in (C), Write "0" in column 3.
** If the "Highest Number of Total Claims Previously Paid For" is less than 20, Write "20" in this space.
*** After any cancelation of claims
**** If "A" is greater than 20, use (B -A); if "A" is 20 or less, use (B - 20).
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reissue Application of	:	
U.S. Patent No.	:	6,039,304
Issued	:	March 21, 2000
For	:	BALL VALVE WITH MODIFIED CHARACTERISTICS
Owner of Record	:	BELIMO AIR CONTROL (USA) INC.
Group Art Unit of Original Application	:	3753
Examiner of Original Application	:	John Fox

HON. COMMISSIONER OF PATENTS AND TRADEMARKS
WASHINGTON, D.C. 20231

Reissue Application

The succeeding pages comprise the Reissue Application.

The amendment to the specification claims priority to a copending U. S. Provisional Patent Application.

The amendment to the claims copies all of the claims of U. S. Patent No. 5,937,890. Claims 1-33 of that patent are set forth herein as claims 10-42.

BALL VALVE WITH MODIFIED CHARACTERISTICS

Related Applications

This application is a Reissue of U. S. Patent No. 6,039,304 which claims priority to U. S. Provisional Patent Application No. 60/062,010 filed August 1, 1997. A divisional U. S. Patent Application No. Serial No. 09/404,739 remains pending.

FIELD OF THE INVENTION

The present invention primarily pertains to control valves used to control the supply of hot or chilled fluid (especially water) to the heat transfer devices used in the heating/ventilation/air conditioning systems in buildings (commonly referred to as the HVAC system). These control valves are generally operated by actuators, which are connected to the temperature control system. The valves are modulated to any suitable intermediate position, so a flow rate that produces the desired temperature is supplied.

BACKGROUND OF THE INVENTION

The flow capacity of the subject control valves must be selected so as to be suitable for each control object. Also, the flow characteristics of the valves must be compatible with the heat transfer characteristics of the control object. Basic ball valves or plug valves have a certain inherent flow characteristic not ideally suited for the above mentioned applications. Also, the flow capacity of such valves, as compared to the size of the valve, is very high. The use of reducing couplings and installing a valve with a smaller size than the basic pipe size tends to further distort the valve characteristics.

U.S. Pat. No. 4,193,580 describes a plug valve which has a special body shape. Among other things, there is brief mention in the patent of ports and seats with a specially shaped opening to give the valve desired flow characteristics. One advantage with the valve disclosed in the '580 patent is that the special opening or seat can be exchanged with another seat which has a differently shaped opening and therefore, gives the valve a different flow capacity and/or flow characteristics. This makes it possible to adapt the disclosed valve for a specific control object. However, in order to change the seats, the valve body has to be taken apart. Therefore, valves that are bolted together and easy to open are preferred, or even necessary, for practice of the disclosure. So called "three piece" ball valves are especially well suited. The three pieces are bolted together, providing easy access to the seats.

A significant disadvantage of the plug valve taught in the '580 patent is that the HVAC market is in general very price sensitive, and therefore relatively inexpensive "two piece" ball valves are often used. The two pieces of such valves are screwed together, and the threads are secured by an epoxy or similar substance. This makes it very difficult (indeed, practically impossible) to take the valve apart in order to exchange the seats. Specifically, if a "two piece" valve is taken apart and reassembled in the field, there is a risk that it may be tightened too little or too much. This will either cause leakage through the seats, or an excessive torque to operate the valve.

An important consideration is that the above mentioned specially shaped seat has to perform two functions. It must provide a tight shut-off when the valve is closed and also provide the desired flow characteristics, when the valve is operated between opened and closed. What is desired, therefore, is a control valve which is inexpensive to manufacture, which is quick and easy to install and change, and which has flow capacity and flow characteristics which can be easily changed without disturbing the integrity of the valve seal.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved control valve in which its flow capacity

and flow characteristics can be easily changed, without having to take the valve apart. Thereby, the integrity of the valve seals will remain intact, and the time consuming operation of taking the valve apart and reassembling it is eliminated.

Another object of the invention is to separate the shut off (sealing) function of the valve from the function that determines the flow coefficient and flow characteristics.

A further object is that when a valve is replaced, the device that determines the flow coefficient and characteristics can be transferred to the new valve.

It is still another object of the present invention to provide a control valve which is inexpensive to manufacture and which can be quickly and easily assembled.

It is still another object of the present invention to provide a control valve which has flow capacity and flow characteristics which can be easily changed without disturbing the integrity of the valve seal.

To overcome the deficiencies of the prior art and to achieve the objects and advantages listed above, a ball valve is disclosed which is slightly modified so it can retain a disk which has a specially shaped opening. The disk is inserted into one of the connection ports of the valve, where it is fastened by a retaining ring or similar device known in the art. The surface of the disk that faces the valve advantageously is concave and corresponds to the spherical surface of the ball inside the ball valve. The disk is preferably mounted with its concave surface very close to the surface of the ball. The disk has an opening (which can be described as generally or essentially V-shaped, although the walls of the opening are not perfectly straight, but, rather, somewhat convex) which interacts with the hole through the ball in such a way that the desired flow coefficient and flow characteristics (typically "equal percent" although other flow characteristics may be desired and achieved) are accomplished, when the ball is turned between the closed and open position.

In another embodiment of the present invention the disk is spring loaded, so it rests upon the ball. This reduces any unwanted flow that passes between the disk and the ball, so essentially the entire flow through the valve is controlled by the opening in the ball and the opening in the disk.

A further embodiment comprises a control valve having a disc having a surface facing the ball, wherein the disc surface is concave as described above, wherein the ball valve has a reduced size port. In a reduced port ball valve the largest diameter of the hole through the ball is smaller than the largest diameter of the hole in the port and seat in the valve body. The reduced size port eliminates the risk that the disk moves into the hole through the ball, when the valve is fully open.

As an alternative, the concave side of the disk can be slightly cantered (one side thicker than the opposed side). This has the effect that the disk only partially rests upon the ball, so any unwanted flow between the disk and ball is minimized when the valve begins to open. The cantered shape makes it possible to use a full ported valve without the risk that the valve will lock up, so it no longer can be operated. (A full ported ball valve has a hole through the ball of the same diameter as the diameter of the port and seat in the valve body.)

The invention and its particular features and advantages will be better understood and its advantages will become more apparent from the following detailed description, especially when read in light of the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cross sectional view of a valve 100, taken along line 1—1 of FIG. 2, valve 100 constructed in accordance with the present invention.

FIG. **2** is an end plan view of the valve **100** shown in FIG. **1**, showing some elements thereof in phantom.

FIG. **3** is a plan view of a first end of a disk **8** housed inside valve **100**, shown in FIG. **1**.

FIG. **4** is a plan view of the side of the disk **8** shown in FIG. **3**, showing some elements thereof in phantom.

FIG. **5** is a plan view of a second end of the disk **8** shown in FIG. **3**.

FIG. **6** is a partially broken away top cross-section view of another preferred embodiment of a valve **102** similar to that of valve **100** of FIG. **1**, showing a disk **8** that is cantered.

FIG. **7** is a side plan view of another preferred embodiment of disk **8**, wherein the side of the disk **8** that is intended to make contact with ring **9** is shaped as a flexible flange **19**.

FIG. **8** is a top cross section view of another preferred embodiment of a valve **106**, wherein the diameter of hole **4** through ball **3** is smaller than the smallest diameter of disk **8**.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. **1–2** in detail, the present invention relates to a valve **100** having modified, and modifiable flow capacity and characteristics. As used herein, the term "front" refers to the "upstream" end of the valve **100**, as that term would be understood by the skilled artisan, and the term "rear" refers to the "downstream" end of the valve **100**.

Although this description is written in terms of valves used in conjunction with fluid flow, especially liquid (i.e., water) flow in HVAC systems, it will be recognized that it is equally applicable to valves in a variety of applications, where modification of flow capacity and/or flow characteristics without the need for disassembly and reassembly of the valve is desired. Additionally, although this specification is written in terms of ball valves, it should be recognized that the invention, and principles relating thereto, is equally applicable to plug valves.

Moreover, it will be recognized that some or all of the attached drawings are schematic representations for purposes of illustration only and do not necessarily depict the actual relative sizes or locations of the elements shown. In addition, for the sake of convenience, not all elements are necessarily shown or numbered in all drawings.

It should be understood that at least four preferred embodiments are shown in FIGS. **1–8**. In each of the Figures, like elements are represented with like reference numerals. For example, although different embodiments of a disk are shown, each disk is represented with reference numeral **8**.

As shown in FIGS. **1–5**, valve **100** comprises main body **1**; screw-in body **2**; ball **3**; hole **4**; shaft **5**; downstream seat **6**; upstream seat **7**; disk **8**; retaining ring **9**; opening **10**; key **11**; upstream port **12**; downstream port **13**; groove **14**; and recess **15** (FIG. **2**). When assembled together, the main body **1** and the screw-in body **2** forms a casing, which has connections for the fluid pipe line. The casing has at least two openings connected to a fluid pipe line (not shown) and has an internal cavity which forms a valve chamber with an upstream port **12** and a downstream port **13** for defining a fluid flow path through the chamber. The valve chamber contains the ball **3** and the seats **6** and **7**.

A ball or plug **3** is mounted in the valve chamber and has an exterior surface and two ends and a fluid passageway **4** extending between the ends and through the plug **3**. The plug also comprises an axis of rotation extending transverse to the

direction of the fluid flow passageway **4**. The plug **3** is rotatable about the axis of rotation for selectively turning the plug between an open position in which the fluid flow passageway **4** is disposed along the fluid flow path of valve **100**. In the closed position the passageway **4** is disposed transverse to the fluid flow path of valve **100**.

Referring in detail to FIG. **1**, the present invention uses a standard ball valve **100**, which has conventional ring-shaped seats of a resilient material. In the text and figures, the direction of flow is described to be from the upstream **12** port to the downstream port **13**. The flow can be reversed, and disk **8** can be mounted and retained at either the upstream **12** or downstream port **13**. It is also possible to use two disks, i.e., to mount and retain a disk **8** at both ports.

Disk **8**, as taught by the present invention, has an opening **4** therein that is specially shaped to produce a desired flow capacity and flow characteristics. Disk **8** is inserted into the valve **100** and secured therein. In the preferred embodiment, and as best shown in FIGS. **1**, **4**, one side of the disk **8** is concave with a curvature approximating that of the exterior spherical surface of ball **3** (in plug valves this shape is generally semicircular). The disk **8** is inserted into the upstream port **12** (for example) and secured by a suitable device, such as a retaining ring **9** adjacent to the seat **7** area. The disk **8** fits the inside diameter of the seat **7** as closely as possible, and the concave surface of the disk **8** follows the spherical curvature of the surface of the ball **3** at a very close distance.

It should be understood that disk **8** is described as concave because it is desired that its exterior surface closely approximate the exterior surface of ball **3**. This has been done for convenience only. It should be further understood that if the plug took on a different shape, then the disk would take on a corresponding different shape, but nonetheless a shape that closely approximated the shape of the plug.

In the disk **8** there is a specially shaped opening **10**, which interacts with the hole **4** in the ball **3**, so the desired flow characteristics is accomplished when the ball **3** is turned between the closed and open positions. In the preferred embodiment, shown in FIGS. **3**, **5**, the opening is essentially V-shaped. The opening inside the disk **8** interacts with the fluid passageway extending between the ends of the plug or ball **3** so that different flow characteristics are achieved when the plug **3** is moved between the open and closed positions.

Referring to FIG. **1**, near the seat **7** area there is a groove **14** in the main body **1** of valve **100**. The groove **14** is sized and shaped to secure the retaining ring **9** in its proper position. Alternatively, it is possible to place the groove **14** in the screw in-body **2**. It is important to install the disk **8** correctly, so the opening **10** can interact with the hole **4** in the ball **3** to accomplished the desired result. This can simply be done by positioning the disk **8** correctly when it is secured by the retaining ring **9**. In order to avoid mistakes and positively secure the position of the opening **10** in the disk **8**, the following can be done. The disk **8** can be provided with a key **11**, and the main body **1** is provided with a corresponding recess **15** (FIG. **2**). The key **11** (FIG. **1**) and the recess **15** (FIG. **2**) determine the position of the disk **8**, and thereby the position of the opening **10**, so the disk **8** can not be rotated versus the rest of the valve **100**. It is of course possible that, instead, the disk **8** has the recess and the main body **1** has the key; other variations would be apparent to those skilled in the art.

In another preferred embodiment not shown in the drawings, the disk **8** could be mounted in the screw-in body **2**. However, the position of the recess **15** is dependent upon

how hard the screw-in body **2** is tightened. Therefore, the location of the recess **15** must be planned, so it ends up at a predetermined position when the screw-in body **2** is screwed in and tightened correctly. Of course, it is instead possible to use no key and recess and just mount the disk **8** positioned correctly.

In the simplest form of the invention, there is a slight clearance between the disk **8** and the curvature of the ball **3**. However, the clearance should preferably be as small as the production tolerances allow. The smaller the clearance is, the better the rangeability will be (the unwanted flow through the clearance will compromise the rangeability of the valve, especially at first, when the valve begins to open. The smaller the unwanted flow, the better the rangeability will be).

Typically, as best shown in FIGS. **1, 5**, the opening **10** in the disk **8** has one pointed narrow end. It is especially important that the clearance is very small at this end. In order to reduce the clearance, the disk **8** can be spring loaded so it presses against the ball **3**. When the valve **100** is fully open, the spring action may move the disk **8** a little bit into the opening **4** of the ball, if valve **100** is a fullported valve. It is possible that this may lock the valve **100**, so it can no longer be operated. This can be avoided by limiting the movement of the ball **3** so that it can not open fully. For example, the movement of ball **3** can be stopped a few degrees before the fully open position. The shaft **5** that turns the ball **3** can have a small arm that makes contact with a protrusion on the body at the desired angle to accomplish this.

An alternative solution is shown in FIG. **8**. It uses a ball valve **106** with a reduced port. The hole **4** through the ball **3** has a smaller diameter than the smallest diameter of the disk **8**. Therefore, the disk **8** can not fit into the hole **4** of the ball **3**. A small reduction in the size of the hole **4** is enough.

The hole **4** can begin and end directly at the spherical surface of the ball **3**. However, it is more advantageous if the ball **3** has a flat surface **20** at the end of the hole **4** where the disk **8** is located. The flat surface **20** should have an outside diameter approximately the same as the disk **8**. A single flat surface **20** can be employed. However, two flat surfaces **20, 21** are shown in FIG. **8**. This is preferred because it prevents the downstream seat **6** from closing ahead of the upstream seat **7**. Also, the ball **3** will be symmetrical so it can be installed in any way. The flat surfaces **20, 21** increase the portion of the angular movement of the ball **3** over which the flow is controlled.

An additional alternative embodiment is shown in FIG. **6** and represented by reference numeral **102**. It utilizes a disk **8** that is cantered because it is slightly thicker at one end **17**. Because the disk **8** is slightly thinner at one end **18**, and the movement of the disk **8** is very small, the thinner end **18** will not reach into the hole **4** in the ball **3**, so when the ball **3** is turned back, the disk **8** will be pushed back out again by a "wedge" action. In the embodiment of FIG. **6**, the turning movement of the ball **3** should be limited, so it can not be moved beyond the fully open and the fully closed positions.

The fact that the disk **8** at at least one end **17** rests upon the ball **3** improves the rangeability of the valve (the clearance will be zero, so the unwanted flow at the start point will be minimal, where it is the most important). Preferably, there is a spring action between the disk **8** and the retaining ring **9**. This can be accomplished by use of an O-ring **16**. FIG. **7** shows another alternative embodiment where the disk **8** is of a semi-resilient material and the end **19** that is in contact with the retaining ring **9** is shaped as a flange **19**,

thus providing a limited spring action. It is also possible to have a retaining ring **9** that is flexible and provides some spring action. This can be accomplished by use of a wave shaped, beveled or slightly conical retaining ring **9**. Instead of using a retaining ring **9**, a short ring with an outside diameter that is threaded to fit the inside diameter of the connecting ports can be used. It is important that sufficient space remains for the connecting fluid pipe line. The spring action can be provided by an O-ring, a spring washer or a flexible flange.

The above text refers to "two piece" ball valves. However, the invention can also be applied to "three piece" ball valves, as well as plug valves. The valve **100, 102, 106** according to the invention offers at least the following advantages:

1. The disk can be designed so the flow capacity (CV-value) is reduced to a desired value. For example, using the same sequence of CV-values that is typical for HVAC control valves of a globe type.
2. The disk can be designed to provide equal percent flow characteristics or any other suitable flow characteristics.
3. A standard low cost ball valve can be used. The only modification of the basic valve is the groove **14** and the optional recess **15**.
4. The disk **8** can be installed or replaced without taking the valve apart.
5. The seats **6** and **7** are not interfered with. The factory adjusted tension and the integrity of the valve remains intact.
6. Because the seats **6** and **7** and the disk **8** are separate parts, each part can be optimized to its function without regard to the other parts.
7. Small inexpensive ball valves are commonly replaced by new valves when the seats are worn out. Because the disk **8** is removable, it is possible to keep the disk **8** and use it in the replacement valve. In doing so, the new valve will have the same flow coefficient and characteristics as the old valve.

The above description is for the purpose of teaching the person of ordinary skill in the art how to practice the present invention, and it is not intended to detail all of those obvious modifications and variations of it which will become apparent to the skilled worker upon reading the description. It is intended, however, that all such obvious modifications and variations be included within the scope of the present invention as defined in the appended claims. The claims are meant to cover the claimed components in any arrangement which is effective to meet the objectives there intended, unless the context specifically indicates the contrary.

What is claimed is:

1. A valve of the type having a casing provided with openings to be connected to a fluid pipe line, wherein at least one of the casing openings forms a groove and having a valve chamber therein with at least one inlet and outlet port for defining a fluid flow path through the valve chamber, the valve comprising:

a plug mounted in the valve chamber and having an exterior surface and two ends and a fluid flow passageway extending between the ends and through the plug, the plug having an axis of rotation extending transverse to the direction of the fluid flow passageway, the plug being rotatable about the axis of rotation for selectively turning the plug between an open position in which the fluid flow passageway is disposed along the fluid flow path between the inlet and outlet ports and a closed position in which the fluid flow passageway is disposed transverse to the fluid flow path;

a disk having an opening therein, the disk located inside at least one of the inlet or outlet ports, the disk having

at least two sides, wherein one of its sides closely conforms with and interfaces with the exterior surface of the plug, wherein the opening of the disk interacts with the fluid passageway extending between the ends of the plug so that different flow characteristics are achieved when the plug is moved between the open and closed positions; and

an internal retaining ring sized and shaped to fit at least partially inside the groove, wherein the disk is retained by the internal retaining ring which is at least partially recessed into the groove in one of the casing openings.

2. The valve of claim 1, wherein the disk opening is essentially V-shaped.

3. The valve of claim 1, the disk comprising a key, the casing comprising a member for cooperating with the disk key, wherein the disk key mates with the cooperating member of the casing.

4. A valve of the type having a casing provided with openings to be connected to a fluid pipe line, wherein at least one of the casing openings forms a groove and having a valve chamber therein with at least one inlet and outlet port for defining a fluid flow path through the valve chamber, the casing further comprising a cooperating member, the valve comprising:

a ball mounted in the valve chamber and having an exterior surface and two ends and a fluid flow passageway extending between the ends and through the ball, the ball having an axis of rotation extending transverse to the direction of the fluid flow passageway, the ball being rotatable about the axis of rotation for selectively turning the ball between an open position in which the fluid flow passageway is disposed along the fluid flow path between the inlet and outlet ports and a closed position in which the fluid flow passageway is disposed transverse to the fluid flow path;

a disk having an essentially V-shaped opening therein, the disk located inside at least one of the inlet or outlet ports, the disk having at least two sides, wherein one of its sides closely conforms with and interfaces with the exterior surface of the ball, the disk comprising a key, wherein the disk key mates with the cooperating member of the casing, wherein the opening of the disk interacts with the fluid passageway extending between the ends of the ball so that different flow characteristics are achieved when the ball is moved between the open and closed positions; and

an internal retaining ring sized and shaped to fit at least partially inside the groove, wherein the disk is retained

by the internal retaining ring which is at least partially recessed into the groove in one of the casing openings.

5. The valve of claim 4, wherein the disk is spring loaded and presses against the ball exterior surface.

6. A valve of the type having a casing having at least two parts one of which is screwed into the other and provided with openings to be connected to a fluid pipe line and having a valve chamber therein with at least one inlet and outlet port for defining a fluid flow path through the valve chamber, the valve comprising:

a plug mounted in the valve chamber and having an exterior surface and two ends and a fluid flow passageway extending between the ends and through the plug which is suspended between two seat rings, the plug having an axis of rotation extending transverse to the direction of the fluid flow passageway, the plug being rotatable about the axis of rotation for selectively turning the plug between an open position in which the fluid flow passageway is disposed along the fluid flow path between the inlet and outlet ports and a closed position in which the fluid flow passageway is disposed transverse to the fluid flow path; and

a disk having an opening therein, the disk located inside at least one of the inlet or outlet ports, the disk having at least two sides, wherein one of the sides of the disk closely conforms with and interfaces with the exterior surface of the plug, and wherein the opening of the disk interacts with the fluid passageway extending between the ends of the plug so that different flow characteristics are achieved when the plug is moved between the open and closed positions, and further wherein at least one of the casing openings further comprises a groove and an internal retaining ring sized and shaped to fit at least partially inside the groove, wherein the disk is retained by the internal retaining ring which is at least partially recessed into the groove in one of the casing openings.

7. The valve of claim 6, wherein one of the sides of the disk is concave and has a diameter not greater than the inside diameter of the seat rings.

8. The valve of claim 6, wherein one of the sides of the disk has a diameter not greater than the inside diameter of the inlet and outlet ports.

9. The valve of claim 6, wherein the casing comprises a recess into which the disk fits and further wherein each seat ring is located inside a dedicated recess separate from the recess for the disk.

* * * * *

[57] **ABSTRACT**

A valve according to the invention having a disk with a shaped opening and one side interfacing with and conforming to the shape of the exterior of the ball or plug. The disk fits inside the port at the seat area, and is secured by a ring. The ring can be threaded into the connection for the fluid pipe line. Alternatively, the connection can have a groove for an internal retaining ring. The disk is positioned so it interacts with the hole in the ball, in such a way that the desired flow characteristics are accomplished.

10. An insert device attachable to a valving member in a ball valve for providing a predetermined flow condition through the ball valve, said insert device comprising:

an insert member having a substantially convex shape corresponding to an outer surface of a valving member to which said insert member may be attached;

a connector on a periphery of said insert member, said connector being adapted to attach said insert member across a passage through the valving member; and

an elongate slot through said insert member, said elongate slot being adapted to provide a predetermined flow condition through the passage of the valving member to which said insert member is attached.

11. The insert device of claim 10, wherein said connector comprises a plurality of legs extending from said periphery of said insert member, said legs being adapted to engage corresponding pockets in the valving member.

12. The insert device of claim 10, wherein said connector includes an aligning member for providing a predetermined orientation of said elongate opening when said insert member is attached across the passage of the valving member.

13. The insert device of claim 10, wherein said insert member comprises a disk having a diameter corresponding substantially to the passage through the valving member.

14. The insert device of claim 13, wherein said convex shape of said disk corresponds to a portion of a sphere, said sphere having an outer periphery substantially similar to the outer surface of the valving member.

15. The insert device of claim 10, wherein said insert member comprises plastic.

16. The insert device of claim 10, wherein said elongate slot comprises an oblong opening.

17. The insert device of claim 10, wherein said elongate slot comprises a parabolic opening.

18. A ball valve for providing a plurality of predetermined flow conditions therethrough, said ball valve comprising:

a valve housing having upstream and downstream passages extending therethrough, said upstream and downstream passages extending into and out of a valve seat within said valve housing, thereby defining a longitudinal axis through said valve seat;

a valving member rotatably mounted within said valve seat, said valving member having a bore extending therethrough, said bore being alignable with said longitudinal axis, said bore and said upstream and downstream passages together defining a fluid passage through said valve housing; and

a plurality of disk-shaped inserts individually attachable across said fluid passage, each of said plurality of inserts having an opening therethrough adapted to provide a predetermined flow condition through said fluid passage.

19. The ball valve of claim 18, wherein said valving member and said plurality of inserts include a connector for attaching one of said plurality of inserts to said valving member across said bore, and wherein said plurality of inserts have a convex outer surface corresponding substantially to an outer surface of said valving member.

20. The ball valve of claim 18, wherein said valve seat and said plurality of inserts include a connector for attaching one of said plurality of inserts to said valve seat across said fluid passage adjacent said valving member, said plurality of inserts having a substantially concave inner surface corresponding to an outer surface of said valving member.

21. The ball valve of claim 18, wherein said opening comprises an elongate opening extending along a plane perpendicular to a transverse axis about which said valving member is rotatable within said valve housing.

22. The ball valve of claim 21, wherein said elongate opening comprises a parabolic opening adapted to provide an equal percentage flow characteristic for said valving member.

23. The ball valve of claim 18, wherein said upstream and downstream passages and said bore have substantially cylindrical cross-sections, and wherein said openings of said plurality of inserts have cross-sections adapted to partially block said fluid passage, thereby providing said predetermined flow conditions.

24. The ball valve of claim 18, wherein said valving member is formed from brass or stainless steel.

25. The ball valve of claim 18, wherein said plurality of inserts comprise plastic.

26. The ball valve of claim 18, wherein said plurality of inserts have a diameter corresponding substantially to a diameter of said bore through said valving member.

27. A ball valve for providing a plurality of predetermined flow conditions therethrough, said ball valve comprising:

a valve housing having upstream and downstream passages extending therethrough, said upstream and downstream passages extending into and out of a valve seat within said valve housing, thereby defining a longitudinal axis through said valve seat;

a valving member rotatably mounted within said valve seat, said valving member having a bore extending therethrough, said bore being alignable with said longitudinal axis, said bore and said upstream and downstream passages together defining a fluid passage through said valve housing; and

a plurality of inserts individually attachable across said fluid passage, each of said plurality of inserts having an opening therethrough adapted to provide a predetermined flow condition through said fluid passage;

wherein said valving member and said plurality of inserts include a connector for attaching one of said plurality of inserts to said valving member across said bore; said connector comprising cooperating legs and pockets, said legs and pockets being formed in said valving member and said plurality of inserts.

28. A ball valve for providing substantially linear volumetric flow control, said ball valve comprising:

a valve housing having a passage extending therethrough along a longitudinal axis thereof;

a valving member seated in said valve housing and having a bore extending therethrough alignable with said passage, said valving member being rotatable about a transverse axis

between open and closed positions, whereby said bore and said passage define a fluid passage adjustable between maximum and minimum flow rates as said valving member is rotated between said open and closed positions respectively; and

a volume control member extending substantially across said fluid passage and having a parabolic opening therethrough, said parabolic opening having a parabolic shape adapted to provide substantially equal percentage flow between said maximum and minimum flow rates when said valving member is rotated each degree of movement between said open and closed positions.

29. The ball valve of claim 28, wherein said volume control member comprises a volume control insert that is attachable across said fluid passage.

30. The ball valve of claim 29, wherein said volume control insert and said valving member include a connector adapted to attach said volume control insert to said valving member across said bore.

31. The ball valve of claim 29, further comprising a valve seat within said valve housing, and wherein said volume control insert and said valve seat include a connector adapted to attach said volume control insert to said valve seat across said passage.

32. The ball valve of claim 29, wherein said connector comprises a leg on said volume control insert adapted to be received in a pocket in said valving member.

33. The ball valve of claim 29, wherein said connector includes an aligning member adapted to orient said parabolic opening along a plane perpendicular to said transverse axis when said volume control insert is attached to said valving member.

34. The ball valve of claim 28, wherein said volume control member comprises a set of volume control inserts individually attachable across said fluid passage, each volume control insert including a different size parabolic opening therethrough, whereby said set of volume control inserts provides a range of predetermined flow conditions through said fluid passage.

35. The ball valve of claim 28, wherein said volume control member forms a portion of a valve seat within said valve housing.

36. The ball valve of claim 28, wherein said volume control member extends across said passage adjacent said valving member.

37. The ball valve of claim 36, wherein said volume control member has a substantially concave inner surface corresponding to an outer surface of said valving member.

38. The ball valve of claim 28, wherein said volume control member is attachable to a valve seat within said valve housing.

39. A ball valve for providing a predetermined flow condition therethrough, said ball valve comprising:

a valve housing having upstream and downstream passages extending therethrough, said upstream and downstream passages extending into and out of a valve seat within said valve housing, thereby defining a longitudinal axis through said valve seat;

a valving member rotatably mounted within said valve seat, said valving member having a bore extending therethrough, said bore being alignable with said longitudinal axis, said bore and said upstream and downstream passages together defining a fluid passage through said valve housing; and

a portion of said valve seat extending across said fluid passage and having an elongate opening therethrough adapted to provide a predetermined flow condition through said fluid passage.

40. The ball valve of claim 39, wherein said portion of said valve seat extending across said fluid passage is detachable.

41. An insert attachable to a valving member rotatably mounted in a ball valve for providing substantially equal percentage flow through a fluid passage extending through the ball valve, the insert comprising:

a disk-shaped member having a substantially convex shape corresponding to an outer surface of the valving member; and

an opening in said disk-shaped member, said opening having a parabolic shape adapted to provide substantially equal percentage flow between maximum and minimum flow rates through

the fluid passage when the valving member is rotated each degree of movement between its open and closed positions.

42. The insert of claim 41, further comprising a connector on a periphery of said disk-shaped member for attaching said disk shaped member across a bore through the valving member.

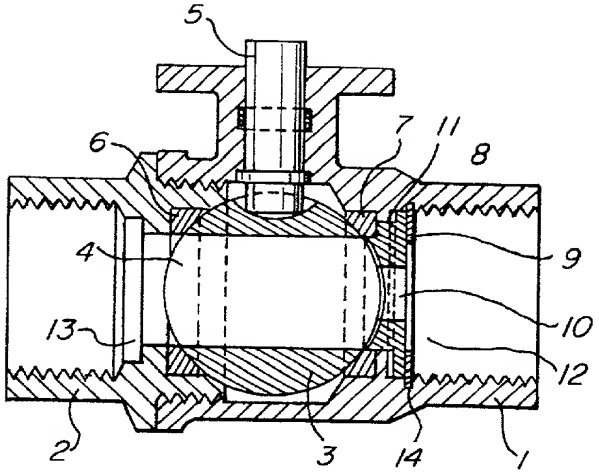

FIG. 1

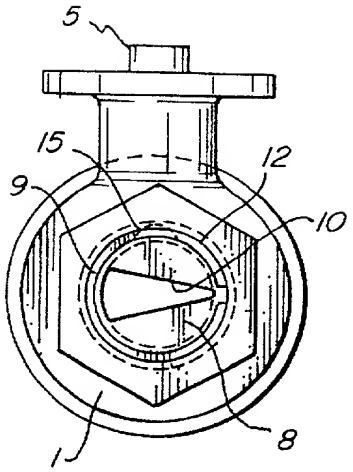

FIG. 2

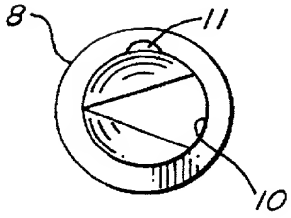

FIG. 3

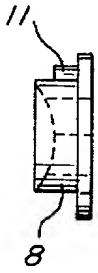

FIG. 4

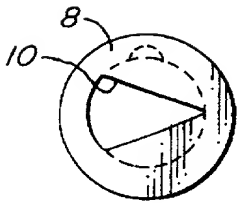

FIG. 5

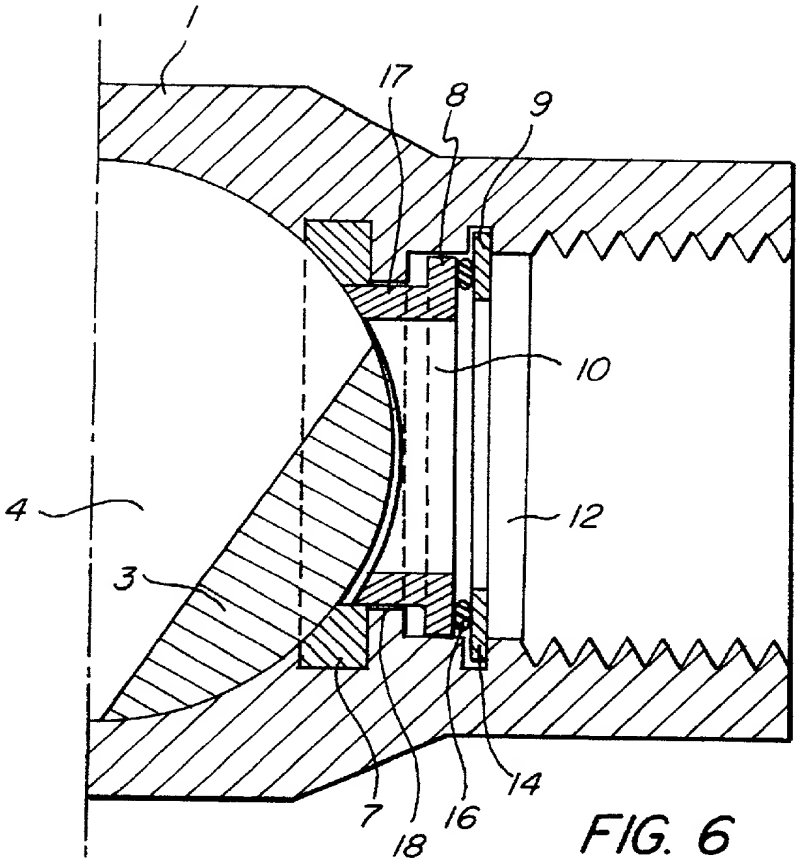

FIG. 6

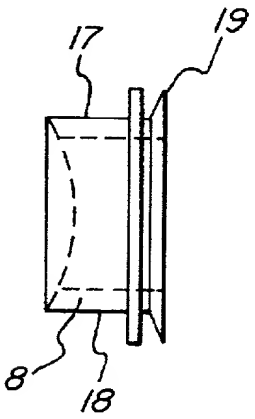

FIG. 7

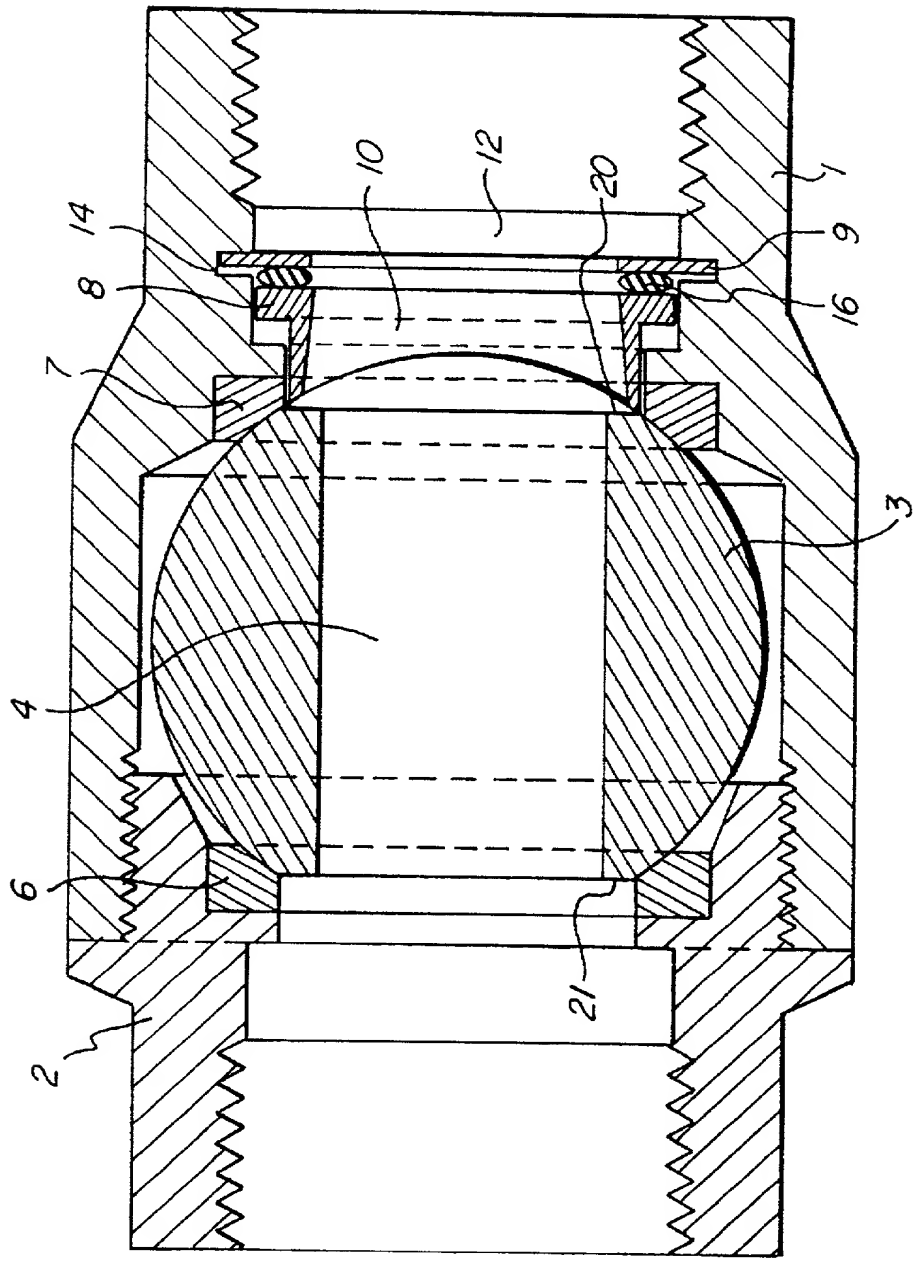

FIG. 8

PTO/SB/51 (12-97)
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Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

REISSUE APPLICATION DECLARATION BY THE INVENTOR	Docket Number (Optional) 835-007.3

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are stated below next to my name.
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is described and claimed in patent number 6,039,304, granted March 21, 2000, and for which a reissue patent is sought on the invention entitled BALL VALVE WITH MODIFIED CHARACTERISTICS,
the specification of which

☒ is attached hereto.

☐ was filed on _____ as reissue application number ___ / _____
and was amended on _____ (if applicable).

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.
I verily believe the original patent to be wholly or partly inoperative or invalid, for the reasons described below. (Check all boxes that apply.)

☐ by reason of a defective specification or drawing.

☒ by reason of the patentee claiming more or less than he had the right to claim in the patent.

☒ by reason of other errors.

At least one error upon which reissue is based is described as follows:

Claims of U.S. Patent 5,937,890 were unknown to applicants during the full period of time from filing U.S. Application Serial No. 09/084,698 until the date of grant, and applicants failed to claim priority to provisional application Serial No. 60/062,010 which wuld have given the application an earlier effective filing date than said patent.

PTO/SB/51 (12-97)
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(REISSUE APPLICATION DECLARATION BY THE INVENTOR, page 2)

Docket Number (Optional): 835-007.3

All errors corrected in this reissue application arose without any deceptive intention on the part of the applicant. As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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OR

Place Customer Number Bar Code Label here

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City	Monroe	State	CT	ZIP	06468
Country	United States of America				
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine and imprisonment, or both, under 18 U.S.C. 1001, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this declaration is directed.

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Date: Aug 17, 2000

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Inventor's signature:

Date: 8/17/2000

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Full name of third joint inventor (given name, family name):

Inventor's signature:

Date:

Residence:

Citizenship:

Post Office Address:

☐ Additional joint inventors are named on separately numbered sheets attached hereto.